

SCIENCE

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IDEALS OF MEDICAL EDUCATION.¹

(Continued from p. 4.)

HAVING thus roughly sketched what is wanted in the way of medical education by different classes of students, — the article for which there is a market, — let us next consider briefly what a university may wisely attempt to provide in this direction. Some suggestions on this point may perhaps be obtained from an examination of the condition of affairs as regards medical education in the University of Oxford.

The Corporation of Oxford has a little more than half the number of inhabitants possessed by the city of New Haven, and its relations to London are, in many respects, similar to those of New Haven with the cities of New York and Boston. For a number of years it has been urged by some physicians in England that the University of Oxford, with her great resources, has not been doing as much for medical education as she should have done, and that it is her duty to establish and maintain a completely organized medical school of the usual pattern, using the small local hospital and dispensary facilities for the clinical side of the work.

On the other hand, other physicians, of whom my friend Sir Henry Acland may be taken as the representative, maintain that it is much better that Oxford should use her resources in giving a broad foundation of literary and scientific culture, including, for those who propose to study medicine, the means of special instruction in general biology, and in comparative and human anatomy, physiology, and pathology; and that the men thus prepared should go to the great hospital medical schools of London to obtain their clinical training; after which they may return and pass their final examinations, and obtain the coveted degree of doctor of medicine from the university.

There is no doubt that this can be done, and that a great part of the scientific foundation of a complete medical training can be furnished by a well-equipped university, with little or no reference to clinical instruction at the same time and place. This, for example, is the course followed by many of the students in the medical department of the University of Virginia, and it seems to me that there is also no doubt that the men who go through such a course of training, followed by clinical training in a great city, will have a better course of instruction, a wider experience, and a better chance of seeing and appreciating the methods of great clinical teachers, than would those who obtained their clinical as well as their scientific training in the small town, or than those who obtain all their instruction in a school devoted exclusively to medical studies. Upon this last point I need not dwell, for Dr. Welch, in his address before you in 1888, has clearly pointed out the advantages of giving to a medical school a university atmosphere, and of making the union of the school and the university close and intimate. It should be noted, however, that the more true this is, the more it is the duty of a university to maintain such a school, because edu-

cational work which cannot be, or is not, done so well elsewhere, has superior claims upon university aid. The chief thing which can be said in favor of the attempt to attract a large number of medical students of average qualifications to an institution having the means to give the higher education are, first, that it brings in more money, and second, that it enables those professors who desire advanced workers, to select these from a somewhat wider field.

It must be confessed that nearly all our great American universities are unwilling to apply their funds to the creation and maintenance of a well-equipped medical department. They are willing to have such a department, no doubt, but they want the money for establishing and maintaining it to be provided in addition to money which has been, or is to be, provided for the general purposes of the university. The ideal university culture of the present day appears to be designed to fit a man to take pleasure in his own thoughts and musings, and in mental exercises in languages, literature, the higher mathematics, and the problems of physics and natural history. Incidentally his knowledge of these things may not only give him pleasure, but enable him to help others; but the studies are not to be pursued on account of any practical utility which they possess, but for the love of learning and pure science, that is, for personal gratification of a particular kind. Those who hold these views are apt to consider medicine as a technological matter, which should be left altogether to special schools, because, being practically useful in a commercial sense, the means of teaching it are sure to be provided through commercial interests, just as they are sure to be provided for the teaching of practical engineering. This is far from the old university idea as embodied in the three faculties and four nations of the University of Paris. So far as the interests of the public are concerned, it is only the possession and control of a large amount and variety of clinical material, or of unusually qualified clinical teachers, which makes it the positive duty to use it, or them, for purposes of medical instruction in order to train ordinary general practitioners of medicine. There is no present deficiency in the number of such practitioners, and we certainly have plenty of schools for producing them, so that there is no fear of failure in the supply.

But in medicine, as in every other profession, art, or trade, the supply of the best is never too great, and the demand for something better than that which already exists never ceases.

What, then, does a university, or its medical school, need in order that it may be able to supply the demand for this higher medical education? First, competent teachers; second, suitable buildings, collections, books, and apparatus; third, clinical material. To secure and retain these things requires money, and brains to use it. First, as to the competent teachers. There are many teachers available, but the number of these who have shown that they are competent for, and suited to positions in a medical school which is to supply the best and something better, is limited — much more so than one who has not tried to find them would suppose, and these few are not seeking engagements. How many anatomists, or physiologists, or pathologists, of the

¹ Address delivered before the Medical Faculty of Yale College, June 23, 1891, by John S. Billings, M.D. (Boston Medical and Surgical Journal.)

first class — thoroughly trained, authorities in their special fields, capable of increasing knowledge, and with the peculiar gift of ability to teach — do you suppose there are in this country? It is a liberal estimate to say that a dozen of each have thus far given evidence that they exist. And the great clinical teachers in medicine and surgery, the men who are up to the times in matters of diagnosis, pathology, and therapeutics, and who are also successful teachers both by the spoken and written word, — how many such have we, and especially how many such have we who are not fixed and established, so that they may be induced to go to a school which needs them? Such men are either men of genius — and even this boasted nineteenth century has produced them rarely — or they are men of talent made the most of by unflagging industry with special opportunities, and these are also rare. Yet these are the men whom a great university should seek to obtain and retain for her faculties. To do this, and to get the best work from such men, is by no means a mere matter of salary, although sufficient salaries must be paid. We have also to consider the buildings, collections, books, and apparatus required, and this is largely a question of money. How much money? What would be the cost of establishing and maintaining a first-class medical school in this country at the present time? Let us suppose that one hundred and fifty students are to be provided for, that the course of instruction for those coming with a good high-school education is to occupy four years, and for those coming with the degree of bachelor of arts, and having done at least one year's work in a chemical laboratory and one year's work in a biological laboratory, the course shall occupy three years; that the last year's studies shall be almost exclusively clinical, and that provision is to be made for advanced post-graduate work.

We shall want, then, practical anatomy rooms for fifty students, a physiological laboratory, a pathological laboratory, a pharmacological laboratory, a laboratory of hygiene, and the means of clinical teaching, a library, and a museum. The days have long gone by when one or two amphitheatres or lecture-rooms and a small museum were all the outfit required for medical teaching. The little amphitheatre of the University of Bologna was sufficient for almost every purpose of medical teaching as it was carried on three hundred years ago, but now the lecture-room is the smallest part of the outfit required. In his evidence before the Royal Commission, Professor Lankester stated that to establish such a medical school at Oxford as he thought desirable, about \$225,000 would be required for buildings, in addition to those already existing, and that about \$100,000 a year would be required for running expenses. Professor Billroth estimates that about \$400,000 would be required for buildings for the medical department of a university, exclusive of the buildings for clinical teaching, which he thinks would cost about as much more; and that the annual expense would be about \$105,000. He says that these estimates are based on an average standard of efficiency, not the highest, and concludes by saying; "Let us hope that a rich man may some day give three millions of dollars to found a school to be devoted to medicine and natural science."

Perhaps these figures may seem high to you. Yet building is cheaper and salaries lower in England and in Germany than with us, if only first-class work and first-class men are accepted. To build and equip a laboratory which shall give work-room for seventy-five men, will cost here between \$75,000 and \$100,000. At least four such laboratories are needed by the ideal medical department, besides a

building for general lectures, library, etc., which would cost about \$50,000.

It is, of course, possible to consolidate all these into a single three or four story building, and thus save money, especially in cost of ground, but the results are not so good. I am not speaking now of temporary, makeshift buildings, but of permanent structures, which though plain should not be hideous, and should be thoroughly well built. Where land is abundant and not too dear, it is usually better to construct these laboratories one at a time, and endeavor to secure for each a proper endowment and equipment. The average expenses of each laboratory may be put at \$15,000 per annum. In other words, it requires about \$400,000 to build, equip, and endow a physiological, pathological, or hygienic laboratory such as is suited to the needs of a first-class university in this country. By paring down in various directions, this sum can be reduced to \$300,000, but not lower without seriously impairing the efficiency of the plan. And in all this I have said nothing of the cost of the means for clinical instruction, which should be borne, in part at least, by the school, for the simple reason that only by doing this can the school have that control of hospital appointments which is so necessary for its proper work.

Of course every professor who is skilled and energetic, and who is imbued with the true university spirit, has innumerable wants and suggestions which require money to supply and carry out. He wants the new books and journals relating to his specialty, specimens, apparatus, models, and illustrations; and if he is at the head of one of the laboratories which I have named, the sum of \$15,000 per annum will be required to pay him and his assistants, and to provide for their needs. All this means that the educating of physicians on this plan will cost the medical department between four and five thousand dollars for each graduate. It will receive from them eight hundred to one thousand dollars each, and the balance must be made up from subscriptions, appropriations, or endowments. Practically, endowment is the only resource.

The student himself has to give four or five years' time and labor, and four or five thousand dollars, to obtain his medical education. For some, this expenditure of time and money will be an excellent investment; for others, not, — even if they have enough of both to spare for this purpose. After all, the most that the university can do is to afford opportunities for learning, and a certain kind and amount of stimulus to mental work. The professor may declare that he will teach certain branches; but there are some sent to him for instruction who are not teachable, and the only thing he can do is to return them as little damaged as possible.

The number of men for whom it is specially desirable to provide laboratory and other special facilities for original work in physiology, pathology, pharmacology, and hygiene is limited. There are not a great number of men who have the desire and qualifications necessary for this sort of work, and the number of positions in which they can find remunerative employment in devoting themselves to such investigations is still more limited.

The laboratory facilities in Germany are, as a whole, at present in excess of the number of properly qualified men who can be found to make use of them, although a few are overcrowded.

Advanced work and original investigations cannot, as a rule, be made by undergraduates, if for no other reason than that of lack of time.

Is it advisable that the same medical school shall undertake to furnish such different courses as to provide for all wants — to offer to meet the minimum requirements for the degree of doctor of medicine, as well as the wants of those who demand more advanced and detailed instruction? The answer to this depends largely on the location of the school, and on the means which it can command, especially as regards facilities for hospital and clinical instruction. In any case, its diploma of doctor of medicine should have a uniform value, and if it does undertake the double function, the higher education must be largely post-graduate work. It must also be, to a great extent, a voluntary matter on the part of both schools and students.

As indicated at the beginning, this address is not intended to criticise existing medical institutions, or to give specific advice to any college or university. I have simply tried to formulate roughly what seems to be the present ideal of a course of medical education in the minds of many physicians, and then to show what the carrying out of this ideal involves to the schools and to the students.

I believe in ideals, that is, in their beauty and in their utility when they do not dominate a man so as to make him a visionary, or a dangerous crank or fanatic; but one ideal is often more or less incompatible with another, and all of them must be held subject to the possibilities afforded by surrounding circumstances. But we must not be too sceptical about these possibilities. And we are all directly interested in this matter, every one of us. Every one of this audience will probably see the time when the knowledge and skill of the physician called in to advise in the calamity which has fallen on him or his wife or child will seem to him of vast importance.

Sometimes he can select his physician, often he cannot, but must rely on the first one who can be found. Hence these discussions about medical education, although chiefly carried on by physicians, because they are most familiar with the difficulties of the subject, should be considered by those who are not physicians quite as much as by those who are, or intend to be. It is a dangerous business, however, for a doctor to discuss other doctors in public. He can make more trouble for himself in less time in this way than by almost any other method that I know of. Nevertheless, it is my duty to tell you that there is little probability that the ideal facilities for higher medical education, either here or elsewhere, will be furnished by the doctors themselves. There are several reasons for this, but one is sufficient, and that is, they have not got the money, which I have shown you is necessary to provide and maintain these facilities. Hence, if these ideals are to be realized, the means must be furnished by those who are not members of the medical profession, and it seems to me that this is what will be done.

What is the best way for a university, a real university, to begin this line of work? In most cases I should say by establishing one department at a time on a proper basis. Which departments should be the first to be thus established? Just here is where many of the doctors will begin to differ.

I should say that the first of these departments to be provided for are two which will form the main links in the university bond between the medical and other departments, covering two branches of knowledge which every university graduate should study somewhat, namely, biology and hygiene. For the clergyman, the teacher, the journalist, and the sociologist, systematic instruction in these two branches

is as desirable as it is for the physician; for the lawyer it will be useful; only the philologist would I excuse entirely from these departments.

Of course, in specifying that they are to teach, and to teach undergraduates, I do not mean that teaching is to be their sole function. This is not the modern idea of a scientific department of a true university. It is to increase knowledge as well, to provide for the needs of special investigators and seekers who have obtained their elementary training elsewhere.

Let the plans for such a department be well thought out, the expenses carefully estimated, and then bring the matter to the attention of those who have the means to realize this ideal, and sooner or later it certainly will be realized. I have elsewhere ventured to express my sympathy for two classes of men who have in all ages and in all countries received much disapprobation from philosophers, essayists, and reformers, namely, rich men and those who want to be rich.

So far as the wealthy are concerned, there seem to be a good many of them in these latter days who use their stored force to endow universities and professorships, to build libraries and laboratories, and to such let us give due praise and honor. They may not be scientific men, but they make scientific men possible. The unscientific mind has been defined as one which is willing to accept and give opinions without subjecting them to rigid tests. "This is the kind of mind which most of us share with our neighbors. It is because we give and accept opinions without subjecting them to rigid tests" that the sermons of clergymen, the advice of lawyers, and the prescriptions of physicians have a market value. The unscientific public has its uses, and one of its characteristics is a liking for ideals, some of which it occasionally helps to realize. I can only hope that whenever an American university approves the ideal which I have roughly sketched, this public will see that the means are provided for carrying it out. It may be objected by some that it would be better to help to raise the average standard by endowing chairs in the medical schools in large cities, than to provide special facilities for the use of a limited number. It is quite true that all medical schools should be endowed; and this is coming, for voluntary associations of physicians, who are not a wealthy class, cannot afford to compete with endowed schools when State laws shall come to enforce a high standard of acquirements. Nevertheless, we need universities properly so called, as well as colleges and higher schools, and we need university men in the medical profession as well as elsewhere.

I have no fears as to the creation of a medical aristocracy by giving facilities for higher education to those who have the means to avail themselves of them. It is quite true that only a fraction of those who have the means will use these facilities properly, and that there will be a number who have not the means who would make good use of such facilities if they could get them; but these last will not be helped by the total absence of such facilities for anybody. Let us try to give the best minds a chance to obtain the best training; let us try to discover these best minds wherever they may be, and if their owners have not the means to avail themselves of training, let us try to furnish the means. But to do this, one of the first and most essential steps is to provide somewhere the teachers, and the buildings and apparatus, necessary for giving such instruction, and where is a better place to do this than in connection with a university, or, if you please, in connection with this university?

NOTES AND NEWS.

IN the table on page 11 of *Science* for July 3, the totals of the third, fourth, fifth, and seventh columns should be 83, 85, 87, and 120 respectively, instead of 82, 84, 86, and 115.

— The University of Pennsylvania has decided to increase the time given to the subjects of mechanical and electrical engineering by providing additional courses in these subjects, extending over four years.

— Entomologists everywhere will deeply regret to hear of the death of Mr. Henry Edwards, who loved his favorite studies quite as much as he did the stage, and brought to both an ardor and freshness contagious and perennial. "Do mention," writes one of his correspondents to *Psyche*, "his unwearying kindness and un-failing help to entomologists who were more ignorant than himself. I owe much to his help and encouragement, and shall miss him sorely, though I never saw his face." and these qualities which so endeared him to a large circle of friends were indeed conspicuous in that face. It is understood that Mr. Edwards left little to his widow besides his collection, which is for sale.

— The tanning of elephant hides is comparatively a new industry, according to the *Boston Journal of Commerce*. The method employed is practically the same as in the tanning of cow hide, except that a stronger combination of the tannic ingredients is required, and greater length of time — about six months — is necessary to perform the work. When the hide is taken out of the vat it is an inch and a half thick. Among the articles made of elephant leather are pocket-books, small satchels, cigar-cases, card-cases, and similar articles, and they are said to be expensive luxuries. In finishing the hide, no attempt is made to glaze or polish it, everything being done to preserve its natural color and appearance. The leather is very enduring, several years' wear having but little effect upon it.

— Some experiments were recently made at the Riverside Iron Works, Wheeling, W. Va., on the comparative liability to rust of iron and soft Bessemer steel. As stated in *Engineering*, a piece of iron plate and a similar piece of steel, both clean and bright, were placed in a mixture of yellow loam and sand, with which had been thoroughly incorporated some carbonate of soda, nitrate of soda, ammonium chloride, and chloride of magnesium. The earth as prepared was kept moist. At the end of 33 days the pieces of metal were taken out, cleaned, and weighed, when the iron was found to have lost 0.84 per cent of its weight and the steel 0.72 per cent. The pieces were replaced and after 28 days weighed again, when the iron was found to have lost 2.06 per cent of its original weight and the steel 1.79 per cent.

— In the Pilot Chart for July the attention of masters of vessels is called once more to the importance of using oil to prevent heavy seas from breaking on board their vessels. The following report, printed in the chart, illustrates the fact that even the largest and most powerful vessels may sometimes derive benefits from its use, and that the precaution is especially necessary when a vessel encounters the terrific seas of a West Indian hurricane. Captain Ringk, of the German steamship "Fulda," reports that at 5 A.M., June 9, in latitude 44° 06' north, longitude 43° 06' west, the wind lulled to a dead calm for a short time and then suddenly sprang up from the south, shifting to south-west and north-west and blowing a perfect hurricane. The sea was like a boiling mass of foam, and the flying spray prevented those on board from seeing far ahead. Soon a very high and heavy sea came up from the west-south-west, and the ship (westward bound) labored heavily and shipped a great deal of water. An oil-bag was then used with great success.

— The following appointments to fellowships in the Johns Hopkins University, for 1891-92, are announced: William Wilson Baden of Baltimore, Sanskrit; Edward Ambrose Bechtel of Coloma, Md., Latin; Julius Blume of Münster, Germany, Romance languages; Albert Bernhardt Faust of Baltimore, German; Simon Flexner of Louisville, Ky., pathology; Ulysses Sherman Grant of Minneapolis, Minn., geology; William Asbury Harris of Richmond,

Va., Greek; Harry Clary Jones of New London, Md., chemistry; James Lawrence Kellogg of Kewanee, Ill., biology; Elmer Peter Kohler of Egypt, Pa., chemistry; Paul Erasmus Lauer of Cleveland, O., history; David Judson Lingle of Chicago, Ill., biology; John Hanson Thomas Main of Baltimore, Greek; Frank Jewett Mather, Jun., of Morristown, N.J., English; Michael Andrew Mikkelsen of Sioux Falls, S.D., history; John Dyneley Prince of New York City, Semitic languages; Brantz Mayer Roszel of Baltimore, astronomy; George Owen Squier of Baltimore, physics; Sydney Grant Stacey of Kezar Falls, Me., Latin; Joseph Moody Willard of Orford, N.H., mathematics.

— The British consul at Hankow, China, writing of the varnish exported from that city, says, according to *Nature*, that he is informed it is the gum of a tree, the *Rhus vernicifera*. On this tree, before daylight, incisions are made, and the gum that runs out is collected in the dark, and strained through a cotton cloth bag, leaving behind a large amount of dirt and refuse. This operation can only be performed in the dark, as light spoils the gum, and causes it to cake with all the dirt in it. It cannot be strained in wet weather, as moisture causes it to solidify. When the Chinese use this varnish, they rub it on with a sort of mop, or swab, made of soft waste silk. It should only be used in wet weather, as, if the atmosphere is dry when it is rubbed on, it will always be sticky. As used by the Chinese, the varnish takes about a month to dry, and during the time it is drying it is poisonous to the eyes. The consul thinks that this gum may have been one of the ingredients of the celebrated Cremona varnish, and he suggests that it might be worth the while of musical instrument makers to experiment with it with a view to producing a varnish that would give a mellow instead of a glassy sound.

— Ever since the story of Robert Bruce and the spider, says a correspondent of *Engineering*, that insect has been proverbially held up to view as an example of pertinacious skill. An attempt to establish instinct as a guide to reason is, however, a fallacy. The setting hen is an example of instinct, not maternal constancy. This perseverance of spiders may have been an encouragement to Robert Bruce, but it is often a discouragement in engineering work. In sinking plumb lines down shafts for middle headings in tunnelling, in order to obtain an alignment for the tunnel, the accuracy of the work is often seriously impaired by spiders attaching their webs to the lines and drawing them towards the walls, often with sufficient tension to introduce material errors in the position of the plumb bobs. In fixing the alignment of the Hoosac Tunnel, in Massachusetts, at the bottom of a shaft 1,028 feet deep, the spiders prevented accurate work with plumb lines, until two cases were made inclosing the whole length of these lines. For shallow pits the spiders' webs can be broken by raising the lines and then lowering them to position shortly before fixing upon points; but in this instance the distance was so great as to require several hours before the vibration of the lines would cease, even with the bobs in vessels of mercury. The suggestion is made that the lines might be freed from similar interferences by insulating the suspended apparatus and the bob from the earth and attaching a grounded electric light circuit to the wire, relying upon the dampness in the pit to give sufficient conductivity to the cobwebs to cause them to be seared by the escape when any cobweb connected the earth to the plumb wire. Many years ago, when the writer used the level with an engineering party, there were frequent difficulties with the instrument. Curved lines like arcs of circles would appear in rapid sequence across the field of vision, which would be nearly eclipsed at times. These difficulties would arise at irregular and generally inconvenient intervals. The instrument was carefully examined without revealing any cause. The writer, distrustful of his own eyesight, visited an eminent oculist, receiving some vague advice and paying a realistic fee. It was afterwards discovered that a minute spider had ensconced himself in the cover of the eyeglass of the telescope of the level. Recently it was found that the meter in the store of a patron of an electric lighting station in America was recording what was a small fraction of the electricity known to be used. The meter was of the revolving fan type, and it was found that a spider had entered the case through a screw hole, and spun a web

in such a manner as to prevent the free revolution of the fans. If gas meters were susceptible to similar treatment it is feared there might be a tendency to perforate the cases and imprison spiders therein.

— Mr. E. H. Kern, of Mankato, Kan., writes as follows to *Insect Life*: "Several seasons ago my potato field was almost ruined because I could not use Paris green, as my stock was in danger from it. A large pond of water attracted about twenty of my neighbor's ducks to its shore. I never did fancy ducks very much, and I told him so. He said he would give them to me if I could care for them, as he could not keep them at home. The next morning I went down to the pond at sunrise to try and drive said ducks in a pen. I saw a very curious sight. Headed by an old drake, the twenty ducks were waddling off in a bee-line for my potato field. I crawled into some bushes and awaited developments. As they came to the end of the rows they seemed to deploy right and left, and such a shovelling-in of bugs I never beheld. They meant business, and for fully one-half hour did they continue, until every duck was filled up to its bill with bugs. Then they went for that pond, and I went for their owner and paid him one dollar for the entire bunch — this being all he would accept. When I returned, every duck seemed to be trying to outdo its fellow in noise. This expedition was repeated about 4 P.M., and kept up until every bug went under. I have tried these ducks and others since, and find they all like them, and seem to get fat on potato bugs."

— Fears had been entertained by the citizens of Provincetown, Mass., for some years before 1867 that the harbor was being silted up by the movement of sands from Lancy's Harbor and House Point Island flats on one side, and from East Harbor on the other side, reinforced by such material as might find its way into the harbor from the south side of Long Point. In 1867 a call was made on the United States Coast Survey by the harbor commissioners of Massachusetts for a re-survey of the harbor of Provincetown. This resulted in a survey during that year by the party of Assistant Henry D. Whiting, followed by a report, published as Appendix No. 12, Coast Survey Report for 1867. In this paper, Mr. Whiting discussed the results of a comparison made with the survey of Major Graham in 1835, treating the subject under three heads; first, with reference to changes at Long Point and on House Point Island flats; second, East Harbor Inlet and Beach Point; and third, the beaches at the head of East Harbor. His recommendations for the construction of works for the improvement of the harbor were based upon the conclusions stated in his report, and some of his suggestions have been carried out. A dike was built by the United States at the "wading place" at High Head in 1838-69. Another dike was built across the outlet of East Harbor creek by the State of Massachusetts, effectually cutting off the water communication between East Harbor and the bay, and in 1870 still another dike was thrown across the head of Lancy's Harbor at Abel Hill, to prevent the flow of the tide from that basin into the main harbor. This dike was rebuilt in 1871. A study of the results of the present comparison points decidedly to the conclusion that these improvements have in great measure arrested the forces which were working toward the injury of the harbor. The success of the dike at Abel Hill in arresting the wash of the sands from Lancy's Harbor only points with stronger emphasis to what should be done to arrest the wash of material from House Point Island flats. So long as the low and narrow sandy barrier to the northward of Wood End lighthouse remains intact, the wash off the flats will remain at a minimum, but should the seas make a breach through the beach during a gale, there is no telling what damage might follow, and it would seem the part of prudence for the Government to heed the recommendation made by Mr. Whiting in 1867, and urged again in 1886 by Major Gillespie, United States engineers, that a dike be built from Stevens Point, in Provincetown, to Long Point, thus effectually inclosing the whole of House Point Island flats. The preservation of Long Point (a natural mole guarding the deep-water basin of the harbor), which has been in charge of the United States engineers, should be secured by ample appropriations from Congress. Two comparative maps accompany the paper of which this note is an

abstract, and which will be published as an appendix to the "Report of the Coast and Geodetic Survey for 1890." In the preparation of these maps reference was made to Major Graham's map of 1835. A comparison of the entire harbor area outside of the mean low-water line shows that in 1835 this area was 1,302 acres, and that in 1867 it had been reduced to 1,247 acres, a loss of 55 acres in 32 years, or one-tenth of one per cent per year. Between 1867 and 1889 the area increased to 1,274 acres, or 27 acres in 22 years, which is at the rate of nine-thousandths of one per cent per year. The maps confirm these results by indicating a resultant shoreward movement of the submerged contours, leading to the conclusion that the conditions since 1867 are most favorable to the maintenance of the present depths.

— "I recently had a curious bean shown to me by a friend," says a correspondent in *Insect Life*, "and, desiring to learn more about this interesting article, I take the liberty of addressing you on the subject, and will thank you kindly for any information you can give me regarding it. The bean in question came from Mexico, is brown in color, and a section through it at right angles to its length would be a triangle. My friend said the name he had heard for it was 'broncho bean,' given from the fact that it had the power of locomotion, by means of quick, short jumps or tumblers, imparted to it, as I have since learned, by a worm, which claims the bean as its home. The muscular effort exerted by the worm on the interior of the bean is sufficient to propel it forward about three-sixteenths of an inch at each jump. To a person who has not heard the reason for the peculiar action of the bean the movement is, to say the least, wonderful. If there is a printed description of this bean, giving the localities in which it may be found, will you kindly advise me of same?" To which the editor replies: "It is the seed of a euphorbiaceous plant believed to be *Colliguaja odorifera* Moline, and the contained 'worm' is the larva of a little tortricid moth known as *Carpocapsa saltitans*, a near relative of the common codling moth (*Carpocapsa pomonella*). It is found chiefly in Sonora, Mexico."

— At a meeting of the Royal Society, London, on May 18, reported in a recent number of *Nature*, Dr. J. Berry Haycraft gave an account of some experiments which show (1) that the displacements of the heart, which since Harvey's time are supposed to take place with every contraction, do not really occur in the unopened chest, and (2) that the cardiogram has been misinterpreted by physiologists. It is usually supposed that, during each contraction, the heart twists towards the right while its apex moves forward, and, pressing against the wall of the chest, causes the "apex beat." Again, it has been supposed by some that, during expansion, all diameters of the heart are not increased, but that, on the contrary, one diameter is diminished in length. Dr. Haycraft's experiments show that all diameters are increased during expansion, and that all are diminished during contraction. They show also that the motions, above described, do not occur in the unopened chest. The heart, in order that it may be observed in the opened chest, is necessarily separated from its attachments and falls towards the back of the chest (the animal operated upon being supposed to be placed upon its back). During expansion, the heart becomes flaccid, and so is flattened against the back of the chest. The first effect of the stiffening which occurs during the muscular contraction is therefore an elevation of the heart, against gravity, towards the front of the chest. Similarly, if the animal be turned upon one side, the heart, during contraction, moves towards the upper side of the chest; and the "beat" can even be made to take place towards the back. In the unopened chest, the heart on the whole remains in position during contraction, and therefore its boundaries move from the chest walls. But the cardiogram, as usually interpreted, shows that the chest wall is thrown outwards by the impact of the heart during contraction. Dr. Haycraft asserts that this is due to deformation of the heart by pressure of the chest wall when the button of the cardiograph is pressed against the exterior of the chest. The first effect of the muscular contraction and stiffening of the heart is therefore increased pressure against the chest-wall, which gives rise to the up-stroke of the cardiogram. When the cardiograph is made as light as possible, the up-stroke is greatly diminished; but it never

entirely vanishes, because the flaccid heart is always slightly distorted by the chest-wall even when the cardiograph is not pressed against it. Dr. Haycraft further shows that the sinuosities, which always appear to a greater or less extent on the cardiogram, are not due to peculiarities in the action of the heart, but are instrumental in their origin, being caused by oscillations which result from the inertia of the cardiograph.

— Writing to the editor of *Insect Life*, Mr. R. J. McGuire, of Rosedale, Miss., says: "Inclosed please find an insect, the name and habits of which you will oblige me by giving. I found it on a willow tree in a swamp on Island 73, in the Mississippi, belonging to Arkansas. I was hunting deer, and being tired lay down under a small willow to rest. After lying there a few moments the air suddenly became filled with little drops of water, as if rain or mist were falling. I got out from under the tree, and as soon as I moved the mist ceased. I stood a short distance away and watched, and gradually came closer, and after watching for half an hour I discovered this little bug on a twig. When I first saw it, it was perfectly quiet, but soon put its head to the limb and immediately minute drops of fluid began to be ejected from the rear end of its body, which extended past or even with the ends of its wings, but since its death it has shrivelled to its present length. The leaves of the tree on which I found it were pierced in thousands of places, and the mist from the tree was thick; but this bug was not on a leaf, but on a small limb. I could find no other insects on the tree, but know there were hundreds. The one I caught slipped around the limb very much as a squirrel would, and I had difficulty in catching it. It made no effort to fly. The natives of the island called the tree a weeping tree, and are very superstitious about it." Replying, the editor says: "The insect which you send is one of the so-called leaf-hoppers, which has been frequently referred to in print on account of its habit of ejecting honey dew and causing the phenomenon of so-called 'weeping-trees.' The scientific name of the one which you send is *Proconia undata*."

— The following appointments from among the graduates of Johns Hopkins University have recently been made: J. William Black, to be professor of history at Georgetown College, Ky.; Charles C. Blackshear, associate professor of chemistry, Woman's College of Baltimore; Benjamin L. Bowen, associate professor of the Romance languages, Ohio State University; Edwin G. Conklin, professor of biology, Ohio Wesleyan University; Paul J. Dashiell, instructor in organic chemistry, Lehigh University; Alfred Emerson, professor of archaeology, Cornell University; Charles H. Haskins, assistant professor of history, University of Wisconsin; George L. Hendrickson, professor of Latin, University of Wisconsin; Francis H. Herrick, Professor of biology, Adelbert College; William H. Hobbs, assistant professor of mineralogy and metallurgy, and curator of the geological museum, University of Wisconsin; Arthur L. Kimball, professor of physics, Amherst College; Oliver P. Jenkins, professor of physiology and histology, Stanford University; James C. Johnston, Loomis fellow in pathology, University of the City of New York; James E. Keeler, professor of astro-physics and director of the observatory at Allegheny City, Penn.; James T. Lees, professor of Greek, University of Nebraska; Henry P. Manning, assistant professor of mathematics, Brown University; W. D. McClintock, assistant professor of English literature, University of Chicago; Dice McLaren, director and agriculturist, Wyoming Agricultural Experiment Station; J. Leverett Moore, associate professor of Latin, Vassar College; Ernest M. Pease, professor of the Latin language and literature, Stanford University; George Petrie, professor of history, Alabama Agricultural and Mechanical College; George M. Richardson, assistant professor of inorganic chemistry, Stanford University; Edward B. Rosa, professor of physics, Wesleyan University; Edward A. Ross, professor of political economy, Indiana University; William T. Sedgwick, professor of biology, Massachusetts Institute of Technology; Robert B. Steele, professor of Latin, Illinois Wesleyan University; Bernard C. Steiner, instructor in history, Williams College; William D. Taylor, professor of civil engineering, University of Louisiana; Edward P. Thompson, professor of mathematics, Westminster College, Penn.; Henry A.

Todd, Professor of Romance languages, Stanford University; William H. Tolman, instructor in history, New York City; Frederick J. Turner, professor of history, University of Wisconsin; Stephen B. Weeks, professor of history and political science, Trinity College, N. C.; Langdon Williams, instructor in history, Chicago, Ill.; Arthur B. Woodford, assistant professor of political economy, University of Pennsylvania.

— The following appointments have recently been made in the Johns Hopkins University: Maurice Bloomfield, now associate professor, to be professor of Sanskrit and comparative philology; William Hand Browne, now librarian and associate, to be associate professor of English literature; James W. Bright, now associate, to be associate professor of English philology; Professor C. T. Winchester to be one of the lecturers on the Donovan foundation for 1891-92; Professor R. C. Jebb to be the lecturer on the Percy Turnbull memorial foundation for 1891-92; Rev. W. M. Taylor and Rev. R. S. Storrs to be the Levering lecturers in 1891-92; Nicholas Murray, now in charge of the publications, to be librarian; J. S. Ames, now assistant, to be associate in physics; C. H. Chapman, now instructor, to be associate in mathematics; Hermann S. Hering to be associate in electrical engineering; John E. Matzke to be associate in the Romance languages; W. W. Randall to continue as assistant in chemistry; Christopher Johnson, Jun., now fellow, to be instructor in Semitic languages; E. S. Lewis, now fellow, to be assistant in Romance languages; C. C. Marden, now of the University of Michigan, to be assistant in Romance languages; W. S. Symington, Jun., to be assistant in Romance languages; Hermann Schoenfeld, of Columbian University, to be instructor in German; George H. Nuttall to be assistant in bacteriology and hygiene; Edward Renouf to be a member of the standing committee on the gymnasium and its secretary; J. B. Crenshaw to be the charge of the gymnasium; G. P. Dreyer to continue in the office of senior demonstrator of physiology; Theodore Hough to continue as junior assistant in the biological laboratory; C. L. Poor, lately a fellow, and now of the College of the City of New York, to be instructor in mathematics; C. A. Smith to be assistant in English; W. A. Scott to be assistant in history; Thomas H. Morgan to hold, for another year, the fellowship in biology founded as a memorial of the late Adam T. Bruce; Edwin G. Conklin to occupy the table allotted to this university in the United States marine laboratory at Wood's Holl.

— Dr. Buchan read a paper before the Royal Society, London, May 18, on the barometer at Ben Nevis observatory, in relation to the direction and strength of the wind (*Nature*, June 18). In arranging the results, Dr. Buchan has referred the direction of the wind to sixteen points of the compass, although the observations are actually made with reference to the thirty-two points. The readings of the barometers at the high-level and the low-level stations, when reduced to sea-level, exhibit marked differences dependent upon the direction of the wind. The investigation extends over the period of nine months commencing in August, 1890. During that time, all the very high winds have been from the east-south east and the south-east, these being the directions in which the wind blows freely along the top of the mountain to the observatory. In eleven cases the wind from these directions attained a speed of 120 miles an hour or more; and the (reduced) barometer at the high-level station read about one-sixth of an inch lower than the instrument at the low-level station. In no other direction was a higher velocity than 70 miles an hour noted; and in the directions from west to north north-west, east, and east-north-east, the velocity was never greater than 30 miles an hour. With northerly winds the instruments at the top of the mountain record a much lower speed than that which, from observations of the drift of the clouds, is seen to be reached at a small height above the top of the mountain. The cause of this comparative calm immediately at the top is the impact of the air upon the face of the cliff which lies to the north of the observatory. The stream lines are thus suddenly deflected upwards. In such cases the depression of the barometer is about three times as great as that which occurs with an equally strong wind from other directions, and indicates the formation of a region of low pressure around the observatory. A peculiar result which is observed with other

directions of the wind is that the (reduced) high-level barometric reading exceeds the (reduced) low-level reading when the wind blows at about the rate of 5 miles an hour. The reverse is always true when the speed of the wind exceeds that rate, on the one hand, or is extremely small, on the other. This seems to indicate an increase of pressure in air-currents which ascends the mountain, and so may explain the fact that the top of the mountain is frequently clear, while dense cloud is being constantly formed at a short distance above it.

— On June 27 a scientific expedition, headed by Professor Lee, instructor in biology at Bowdoin College, sailed from Rockland, Me., for Labrador. Of the seventeen members of the party with Professor Lee, nearly all are undergraduates of Bowdoin. The intention is to land four of the party at Hamilton Inlet for a tour of exploration inland, following the inlet and Grand River. The rest of the party will go as far north as Cape Chudleigh.

— The formal transfer of the Weather Bureau from the War Department to the Department of Agriculture took place on July 1. The first official act after the transfer was the appointment of the new chief, Professor Mark W. Harrington of Michigan. Professor Harrington is now and has been for the last twelve years professor of astronomy in the University of Michigan, at Ann Arbor, and editor of the *American Meteorological Journal*. He is about 43 years old. Acting Secretary Grant signed an order on the last day of June discharging the 163 employees of the signal service then engaged in the Weather Bureau. The list is headed by Professor Abbe and ends with the first-class sergeants. Under the law the Secretary of Agriculture is bound to give preference to these men in making appointments for the new Weather Bureau, and, with the exception of a few men who elected to remain in what will hereafter be the purely military branch of the signal service, all of the employees who were engaged in the Weather Bureau will be reappointed.

— According to Professor Elihu Thompson, says *Engineering*, it is not the extra resistance at the break that gives rise to the heating in electric welding. The imperfect contact there no doubt hastens the heating at the joint, but a solid bar placed between the clamps of an electric welding machine can also be raised to the welding temperature, and the bar may be upset there. The real cause of the concentration of the heating between the clamps is the relatively greater conductivity of other portions of the welding circuit, which is usually composed of massive copper conductors kept cool in the case of large work by the circulation of water. By keeping the conductors cool in this way their resistance is maintained constant, and there follows an accentuation of heating effect at the joint, where the rise in temperature increases the resistance. In large works it has been found that hydraulic power can be advantageously employed both for clamping and making contact with the pieces to be welded or worked. In dealing with metals such as lead, tin, and zinc, the temperature required for welding is so low that the metal never glows, and the progress of the heating cannot be watched with the eye. By properly shaping the ends leaden water pipes can easily be welded together end to end. The meeting edges should be thinned so as to reduce the surface of contact below the area of the pipe wall. Joints thus made are very good and sound. Most metals can be welded without the use of a flux, but for good work a flux is often desirable.

— The supplement to the Pilot Chart of the North Atlantic for July illustrates graphically and by means of a tabular statement the drift of every bottle-paper (showing the drift of floating bottles) returned to the hydrographic office at Washington since April, 1889. A small chart of this kind was published last November, but the present supplement is complete up to date. The number of bottle-papers received was 134, of which 119 were from the North Atlantic. The total number of miles drifted by these 119 papers is 103,444, giving an average of 869 miles. There are 113 papers that contain the date of commencement and end of journey, from which the total number of days can be calculated. For these 113 papers the total number of days is 16,969, giving an average of 150 days to each paper. Dividing the average drift by the average number of days, it is found that 5.8 miles per day is the average drift. This figure, it should be remembered, is of

necessity less than the true average rate per day, because every day that a bottle lies undiscovered on the beach counts on its time of drift, the apparent elapsed time being thus too great and the average drift per day too small. It is proposed to continue the publication of bottle papers as often as possible, not only for the Atlantic but for other oceans, and masters of vessels and others interested are urged to co-operate with the hydrographic office in collecting as complete data as possible regarding this general subject. Any reliable reports of long drifts of bottle-papers, or any other floating objects, will be of interest in this connection, and the accumulation of such data may add considerable useful information to our knowledge of the general drift of ocean currents.

— On Thursday, May 21, says the *Lancet*, the body of an Arab, found dead on one of the ships in the Albert Docks, was taken to the Seamen's Hospital, name unknown. A necropsy was ordered by the coroner, and made by Dr. F. Croucher, house surgeon to the branch hospital. There were no signs of disease in the brain or the chest, except a few old adhesions in the left pleural cavity. The gall bladder was very distended and full. Three small ulcers existed on the anterior coat of the stomach. Several patches of inflammation were found in the small intestine. In the cæcum were found twenty buttons, three cog-wheels (apparently out of a watch, two of them one inch in diameter, and doubled), one two-inch steel screw bent double, and one one-inch screw, six pieces of a lock (the biggest piece one and a half inch long and one and a half inch broad), a circular piece of brass (one and three-quarter inch in diameter folded into four), several pieces of iron wire (four were one and a half inch in length), brass, and lead, and two key tallies on a ring, one inch in length. In the ascending colon, about five inches from the cæcum, were found a piece of steel wire one eighth of an inch in diameter, and three inches and a half in length, bent double, and one small cog-wheel. The weight of these bodies together amounted almost exactly to half a pound. The body was much emaciated; no subcutaneous fat was present in chest or abdominal walls, or any fat round the kidneys. The deceased was quite unknown; no particulars could be discovered by the police employed to obtain evidence for the purposes of the inquest. There was no perforation of intestines, nor any sign of disease in the colon.

— Dr. Roland Thaxter has received an appointment as assistant professor of cryptogamic botany and Mr. J. G. Jack as arboretum lecturer for 1891-92 at Harvard University.

— Dr. J. F. Williams of the Geological Survey of Arkansas has been appointed assistant professor of geology at Cornell University. He has in press a volume upon the igneous rocks of Arkansas.

— J. M. Stedman, formerly of Cornell University, now of the United States Department of Agriculture, has just accepted an invitation to the chair of biology in Trinity University, Durham, N.C. This institution has been completely reorganized, and will open in September, with the following new departments: medical college; law school; schools of arts, literature, political and social science, and divinity; and a college of the sciences.

— Mr. John M. Barr, well known as a member of the American Society of Mechanical Engineers, and now professor of mechanical engineering at the University of Minnesota, has resigned his position to accept a call to Sibley College, Cornell University, where he will have special charge of the whole line of junior work in machine-design lately conducted by Professor A. W. Smith. Professor Smith goes to the University of Wisconsin for the present, with the expectation that he may go to the Stanford University a year later.

— Mr. C. H. Tyler Townsend some time ago resigned his position in the Division of Entomology, United States Department of Agriculture, to accept the post of entomologist to the State experiment station of New Mexico. By a competitive civil service examination his place has been filled by Mr. F. H. Chittenden of New York, formerly editor of *Entomologica Americana*, and curator and corresponding secretary of the Brooklyn Entomological Society. Mr. A. B. Cordley, formerly entomologist of the Agricultural experiment station of Vermont, has also been appointed to a position in the division.

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

THE FARADAY CENTENARY.

ON Wednesday, June 17, at the Royal Institution, London, Lord Rayleigh delivered a lecture in connection with the one hundredth anniversary of Faraday's birth. The following abstract of the lecture is from *Nature* of June 25.

Lord Rayleigh said that the man whose name and work they were celebrating was identified in a remarkable degree with the history of that institution. If they could not take credit for his birth, in other respects they could hardly claim too much. During a connection of fifty-four years, Faraday found there his opportunity, and for a large part of the time his home. The simple story of his life must be known to most who heard him. Fired by contact with the genius of Davy, he volunteered his services in the laboratory of the institution. Davy, struck with the enthusiasm of the youth, gave him the desired opportunity, and, as had been said, secured in Faraday not the least of his discoveries. The early promise was indeed amply fulfilled, and for a long period of years, by his discoveries in chemistry and electricity, Faraday maintained the renown of the Royal Institution and the honor of England in the eye of the civilized world. He should not attempt in the time at his disposal to trace in any detail the steps of that wonderful career. The task had already been performed by able hands. In their own "Proceedings" they had a vivid sketch from the pen of one whose absence that day was a matter of lively regret. Dr. Tyndall was a personal friend, had seen Faraday at work, had enjoyed opportunities of watching the action of his mind in face of a new idea. All that he could aim at was to recall, in a fragmentary manner, some of Faraday's great achievements, and if possible to estimate the position they held in contemporary science.

Whether they had regard to fundamental scientific import, or to practical results, the first place must undoubtedly be assigned to the great discovery of the induction of electrical currents. He proposed first to show the experiment in something like its original form, and then to pass on to some variations, with illustrations from the behavior of a model, whose mechanical properties were analogous. He was afraid that these elementary experiments would tax the patience of many who heard him, but it was one of the difficulties of his task that Faraday's discoveries were so fundamental as to have become familiar to all serious students of physics.

The first experiment required them to establish in one coil of copper wire an electric current by completing the communication with a suitable battery; that was called the primary circuit, and Faraday's discovery was, that, at the moment of the starting or stopping of the primary current, then, in a neighboring circuit, in the ordinary sense of the words, completely detached, there was a tendency to induce a current. He had said that those two circuits were perfectly distinct, and they were distinct in the sense that there was no conducting communication between them, but, of course, the importance of the experiment resided in this, — that it proved that in some sense the circuits were not distinct; that an electric current circulating in one does produce an effect in the other, which is propagated across a perfectly blank space occupied by air, and which might equally well have been occupied by vacuum. It might appear that that was a very simple and easy experiment, and of course it was so in a modern laboratory, but it was otherwise at the time when Faraday first made it. With all his skill, Faraday did not light upon truth without delay and difficulty. One of Faraday's biographers thus wrote: "In December, 1824, he had attempted to obtain an electric current by means of a magnet, and on three occasions he had made elaborate and unsuccessful attempts to produce a current in one wire by means of a current in another wire, or by a magnet. He still persevered, and on August 29, 1831, — that is to say, nearly seven years after his first attempts, — he obtained the first evidence that an electric current induced another in a different circuit. On Sept. 23 he writes to a friend, 'I am busy just now again with electro-magnetism, and think I have got hold of a good thing, but cannot say; it may be a weed instead of a fish that, after all my labor, I at last haul up.'" We now know that it was a very big fish indeed.

About the time that the experiments of which he had been speaking were made, Faraday evidently felt uneasiness as to the soundness of the views about electricity held by his contemporaries, and to some extent shared by himself, and he made elaborate experiments to remove all doubt from his mind. He re-proved the complete identity of the electricity of lightning and of the electricity of the voltaic cell. He was evidently in terror of being misled by words which might convey a meaning beyond that which facts justified. Much use was made of the term "poles" of the galvanic battery. Faraday was afraid of the meaning which might be attached to the word "pole," and he introduced a word since generally substituted, "electrode," which meant nothing more than the way or path by which the electricity was led in. "Electric fluid" was a term which Faraday considered dangerous, as meaning more than they really knew about the nature of electricity, and, as was remarked by Maxwell, Faraday succeeded in banishing the term "electric fluid" to the region of newspaper paragraphs.

Diamagnetism was a subject upon which Faraday worked, but it would take too long to go into that subject, though a word or two must be said. Faraday found that whereas a ball of iron or nickel or cobalt, when placed near a magnet or combination of magnets, would be attracted to the place where the magnetic force was the greatest, the contrary occurred if for the iron was substituted a corresponding mass of bismuth or of many other substances. The experiments in diamagnetism were of a microscopic character, but he would like to illustrate one position of Faraday's, developed years afterwards by Sir William Thomson, and demonstrated by him in many beautiful experiments, only one of which he now proposed to bring before them. Supposing they had two magnetic poles, a north pole and a south pole, with an iron ball between them, free to move along a horizontal line perpendicular to that joining the poles, then, according to the rule he had stated, the iron ball would seek an intermediate position, the place at which the magnetic force was the greatest. Consequently, if the iron ball be given such a position, they would find it tended with considerable force to a central position of equilibrium; but if, instead of using opposite poles, they used, e.g., two north poles, they would find that the iron ball did not tend to the central position, because that was not the position in which the magnetic force was the greatest. At that position there was no magnetic force, for the one pole completely neutralized the action

of the other. The greatest force would be a little way out, and that, according to Faraday's observations, systematized and expressed in the form of mathematical law by Sir William Thomson, was where the ball would go.

The next discovery of Faraday to which the lecturer called attention was one of immense significance from a scientific point of view, the consequences of which were not even yet fully understood or developed. He referred to the magnetization of a ray of light, or what was called in more usual parlance the rotation of the plane of polarization under the action of magnetic force. It would be hopeless to attempt to explain all the preliminaries of the experiment to those who had not given some attention to those subjects before, and he could only attempt it in general terms. It would be known to most of them that the vibrations which constituted light were executed in a direction perpendicular to that of the ray of light. By experiment he showed that the polarization which was suitable to pass the first obstacle was not suitable to pass the second, but if by means of any mechanism they were able, after the light had passed the first obstacle, to turn round the vibration, they would then give it an opportunity of passing the second obstacle. That was what was involved in Faraday's discovery. As he had said, the full significance of the experiment was not yet realized. A large step towards realizing it, however, was contained in the observation of Sir William Thomson, that the rotation of the plane of polarization proved that something in the nature of rotation must be going on within the medium when subjected to the magnetizing force, but the precise nature of the rotation was a matter for further speculation, and perhaps might not be known for some time to come.

When first considering what to bring before them, the speaker thought, perhaps, he might include some of Faraday's acoustical experiments, which were of great interest, though they did not attract so much attention as his fundamental electrical discoveries. He would only allude to one point which, as far as he knew, had never been noticed, but which Faraday recorded in his acoustical papers. "If during a strong steady wind, a smooth flat sandy shore, with enough water on it, either from the receding tide or from the shingle above, to cover it thoroughly, but not to form waves, be observed in a place where the wind is not broken by pits or stones, stationary undulations will be seen over the whole of the wet surface. . . . These are not waves of the ordinary kind; they are (and this is the remarkable point) accurately parallel to the course of the wind." When he first read that statement, many years ago, he was a little doubtful as to whether to accept the apparent meaning of Faraday's words. He knew of no suggestion of an explanation of the possibility of waves of that kind being generated under the action of the wind, and it was, therefore, with some curiosity that two or three years ago, at a French watering-place, he went out at low tide, on a suitable day when there was a good breeze blowing, to see if he could observe anything of the waves described by Faraday. For some time he failed absolutely to observe the phenomenon, but after a while he was perfectly well able to recognize it. He mentioned that as an example of Faraday's extraordinary powers of observation, and even now he doubted whether anybody but himself and Faraday had ever seen that phenomenon.

Many matters of minor theoretic interest were dealt with by Faraday, and reprinted by him in his collected works. The speaker was reminded of one the other day by a lamentable accident which occurred owing to the breaking of a paraffin lamp. Faraday called attention to the fact, though he did not suppose he was the first to notice it, that, by a preliminary preparation of the lungs by a number of deep inspirations and expirations, it was possible so to aerate the blood as to allow of holding the breath for a much longer period than without such a preparation would be possible. He remembered some years ago trying the experiment, and running up from the drawing-room to the nursery of a large house without drawing any breath. That was obviously of great practical importance, as Faraday pointed out, in the case of danger from suffocation by fire, and he thought that possibly the accident to which he alluded might have been spared had the knowledge of the fact to which Faraday drew attention been more generally diffused.

The question had often been discussed as to what would have been the effect upon Faraday's career of discovery had he been subjected in early life to mathematical training. The first thing that occurred to him about that, after reading Faraday's works, was that one would not wish him to be anything different from what he was. If the question must be discussed, he supposed they would have to admit that he would have been saved much wasted labor, and would have been better *en rapport* with his scientific contemporaries if he had had elementary mathematical instruction. But mathematical training and mathematical capacity were two different things, and it did not at all follow that Faraday had not a mathematical mind. Indeed, some of the highest authorities (and there could be no higher authority on the subject than Maxwell) had held that his mind was essentially mathematical in its qualities, although they must admit it was not developed in a mathematical direction. With these words of Maxwell he would conclude: "The way in which Faraday made use of his idea of lines of force in co-ordinating the phenomena of electric induction shows him to have been a mathematician of high order, and one from whom the mathematicians of the future may derive valuable and fertile methods."

THE "SUBMARINE SENTRY."

At a recent meeting of the Royal United Service Institution, London, a lecture upon sounding machines was given by Professor Lambert of the Royal Naval College, Greenwich. In the course of the lecture (some details of which appear in *Engineering* of June 26) a description was given of an instrument called a "submarine sentry," which has been successfully experimented with on some ships of the British navy. It is the invention of Mr. Samuel James, a civil engineer.

As described by the lecturer, the sentry is intended to give a continuous under-water look-out, and to automatically give warning of the approach of shallow water. It consists of an inverted wooden kite, which can be trailed at the stern of a vessel at any required depth to forty-five fathoms. On striking bottom, the blow, acting on a projecting trigger, releases the slings of the kite and causes it to rise to the surface and trail in the wake of the vessel. At the instant of striking, the sudden loss of tension in the wire sounds a gong attached to a winch on board the ship. The wire used is of steel, and of the highest tenacity attainable. Its diameter is 0.067 of an inch, and it is capable of bearing a stress of fully a thousand pounds. During towing the vibration of the wire causes a continuous rattle in a sounding box, and the cessation of this noise gives an additional indication when the sentry has struck the bottom. The vertical depth of the kite at any time is indicated on the dial plate of the winch. The curve formed by the wire while towing is concave downwards, and at first sight it would appear as if this curve would change its form, and the sinker trail further astern and at less depth when the ship's speed was increased. Professor Lambert had carefully plotted out this curve, and showed the results on a diagram. By a mathematical analysis he showed that the instrument would remain constant in its record at any speed of the ship between five and fifteen knots. The weight of the kite is equal to, and is therefore neutralized by, its own buoyancy, and the weight of the wire is negligible compared to the forces due to the motion through the water.

The forces which remain to be considered are, (1) the fluid pressure on the kite, (2) the fluid pressure on the under side of the wire, and (3) the tension of the wire. The latter is the result of the two former. Pressures due to fluid motion vary nearly as the square of the velocity. If, therefore, the velocity of the ship be doubled, forces (1) and (2) will each be multiplied by four, the three forces will all be changed proportionally, and there will be no change in the direction in which they act. This is only put forward as a rough explanation of the phenomena, but that it is practically true has been, it is claimed, corroborated by practical tests, — the depth of the sinker not varying more than half a fathom in thirty at speeds of from five to thirteen knots, above which speed the instrument is not designed to be used.

There are two descriptions of kite, one set at an angle to give

soundings down to thirty fathoms, and the other slung so as to register down to forty-five fathoms. With the former about four and a half horse-power is absorbed at a speed of eight knots. It should be stated that the apparatus can be used for taking soundings at any depth within its limits of working, as well as to form a permanent indication of when the ship passed into water of less than a given depth. All that is required to do is to pay the kite out slowly, with a hand on the brake which is provided for checking the speed. When the gong sounds, a glance at the dial will show the vertical depth due to the length of wire paid out.

EXPERIMENTS WITH LEYDEN JARS.

At a meeting of the Physical Society, London, held June 12 (reported in *Engineering* of June 19), some experiments with Leyden jars were shown by Dr. Lodge. The first one was with resonant jars, in which the discharge of one jar precipitated the overflow of another when the lengths of the jar circuits were properly adjusted or tuned. The latter jar was entirely disconnected from the former, and was influenced merely by electro-magnetic waves emanating from the discharging circuit. Lengthening or shortening either circuit prevented the overflow. Correct tuning was, he said, of great importance in these experiments, for a dozen or more oscillations occurred before the discharge ceased. The effect could be shown over considerable distances. In connection with this subject Mr. Blakesley had called his attention to an observation made by Priestley many years ago, who noticed that when several jars were being charged from the same prime conductor, if one of them discharged, the others would sometimes also discharge, although they were not fully charged. This he, Dr. Lodge, thought might be due to the same kind of influence which he had just shown to exist. The word "resonance," he said, was often misunderstood by supposing it always had reference to sound, and as substitutes he thought that "sympsoning" or "sympsonic" might be allowable.

The next experiment was to show that wires might be tuned to respond to the oscillation of a jar-discharge, just as a string could be tuned to respond to a tuning-fork. A thin stretched wire was connected to the knob of a jar, and another parallel one to its outer coating, and, by varying the length of an independent discharging circuit, a glow was caused to appear along the remote halves of the stretched wires at each discharge. Each of the wires thus acted like a stopped organ pipe, the remote ends being the notes at which the variations of pressure are greatest. By using long wires he had observed a glow on portions of them with the intermediate parts dark: this corresponded with the first harmonic, and by measuring the distance between two nodes, he had determined the wave length of the oscillations. The length so found did not agree very closely with the calculated length, and the discrepancy he thought due to the specific inductive capacity of the glass not being the same for such rapidly alternating pressures as for steady ones. He also showed that the electric pulses passing along a wire could be caused (by tuning) to react on the jar to which it was connected, and cause it to overflow, even when the distance from the outside to the inside coating was about eight inches. During this experiment he pointed out that the noise of the spark was greatly reduced by increasing the length of the discharging circuit. The same fact was also illustrated by causing two jars to discharge into each other, spark gaps being put both between their inner and outer coatings, so as to obtain "A" sparks and "B" sparks. By putting on a long "alternative path" as a shunt to the B spark gap, and increasing that gap, the noise of the A spark was greatly reduced. He had reason to believe that the B spark was a quarter phase behind the A spark, but the experimental proof had not been completed.

He next described some experiments on the screening of electro-magnetic radiation, in which a Hertz resonator was surrounded by different materials. He had found no trace of opacity in insulators, but the thinnest film of metal procurable completely screened the resonator. Cardboard rubbed with plumbago also acted like a nearly perfect screen. In connection with resonators he exhibited what he called a graduated electric eye, or an electric harp, made by his assistant, Mr. Robinson, in which strips

of tinfoil of different lengths are attached to a glass plate, and have spark gaps at each end which separate them from other pieces of foil. One or other of the strips would respond according to the frequency of the electro-magnetic radiation falling upon it.

A GIFT TO THE UNIVERSITY OF CHICAGO.

THE executors of the estate of the late William B. Ogden, who was the first mayor of Chicago, have selected the University of Chicago as one of the beneficiaries under the terms of Mr. Ogden's will, — giving it a scientific school.

The conditions attached by the executors to the gift — which will amount to from three hundred thousand to half a million dollars — are, that the school shall be a separate department of the university, and bear the name of the Ogden Scientific School, its purpose being to furnish graduate students with the best facilities possible for scientific investigation by courses of lectures and laboratory practice. The income of the money appropriated is to be devoted to and used for the payment of salaries and fellowships, and the maintenance of laboratories in physics, chemistry, biology, geology, and astronomy, with the subdivisions of these departments. A large share of the time of the professors in the school is to be given to original investigation, and encouragement of various kinds is to be furnished them to publish the results of their investigations, a portion of the funds being set apart for the purpose of such publication. The school is to include all the graduate work of the university on the subjects mentioned, and further appropriations or donations which may be made toward these objects are to be added to the original foundation, and not to be devoted to new schools doing similar or parallel work. Some portion of the income of the foundation is to be set apart for the purchase of books to be placed in the special departmental and laboratory libraries of the proposed school.

The university in accepting this gift is required to pledge itself to erect the contemplated school, under the suggested name, on the receipt of \$300,000, whether or not the wish and expectations of the trustees be realized in the final receipt from the fund of a much larger sum. In the event, however, of any unforeseen circumstances preventing the money designated from reaching the sum of \$300,000, the money which may be received shall be used for the endowing of one or more professorships in the university to be severally known as the Ogden Professorships.

It is further desired that at least one of the board of trustees of the university shall be the nominee of the executors and trustees of Mr. Ogden's estate, in order that in the formation and development of the scientific school proposed, the wishes of the trustees may be voiced by at least one member of the governing board of the university. And finally it is required that it shall be distinctly understood that there shall be absolute freedom in respect to the admission to the proposed school of students and professors alike, without reference to their particular religious beliefs.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Dissipation of Energy.

IN passing through a grove of scattered timber after a recent thunder-storm, I came to a tree that had been struck by lightning, a honey-locust (*Gelditschia*), about two feet in diameter.

At the bifurcation of the topmost limbs the bark and sap-wood were torn off for two or three inches in width, increasing as it passed down, until within ten feet of the ground, where it seemed to pass in and explode from the centre, splintering the tree on one side for a foot or two, then tearing the bark and sap-wood for a little ways down, and then leaving the rest without a mark on it for two or three feet above the roots. The splinters were scattered in a half circle twenty feet from the tree. The tree appeared to be perfectly sound and free from defect.

Some years ago I saw something similar in an eastern State. A hemlock tree, two feet in diameter, had a small streak of bark taken off one side from the top down for ten or twelve feet, and then the whole body of the tree was shattered, and as much as six feet of it scattered in every direction, and the top was left standing erect on the stump. There were no marks on the tree below the splintered part.

In both cases there seemed to be no evidence of cracks or defects previous to the explosion.

P. J. FARNSWORTH.

Clinton, Iowa, June 28.

The Relations of the Eastern Sandstone of Keweenaw Point to the Lower Silurian Limestones.

ONE of the assistants (Mr. W. L. Honnold) of the Michigan Geological Survey has been engaged in the study of the relations of the limestone west of L'Anse to the eastern or supposed Potsdam sandstone of the copper-bearing range. This locality is described in Jackson's Report (1849, pp. 399, 452), Foster and Whitney's Report (part 1., 1850, pp. 117-119), and in Rommger's Report (1873, I. part 3, pp. 69-71); and the limestone considered from its fossils to be Trenton or some adjacent Lower Silurian strata. It was inferred by Jackson that the limestone underlies the sandstone, but by the other observers that it overlies it, although no direct contact was seen.

Excavations made by Mr. Honnold's party and reported by him have developed the contact of the two formations, and show that the two form a synclinal or oblong basin-shaped fold, with the limestone overlying, and in direct contact with the sandstone. The existence of this fold in the sandstone, as well as in the limestone, removes the difficulty previous observers have had in reconciling the obviously tilted limestone with the supposed horizontal sandstone, and proves that the eastern sandstone exposed here is of Lower Silurian age, and older than this limestone.

At the point of contact of the two formations, exposed by excavation, the sandstone and limestone appear to be conformable, and they are seen to constantly agree in dip and strike. The contact between the two formations is abrupt, without any beds of passage, although the upper layers of the sandstone contain considerable carbonate of lime and magnesia, and the lower layers of the limestone much silica.

These observations are considered to be confirmatory of the commonly received view of the Potsdam age of the eastern sandstone; while the contorted state of the sandstone, extending at least a mile and a half west from the limestone locality, may have weight in deciding the relative age of the eastern sandstone and the copper-bearing rocks.

A careful study of the fossils will be made and additional field work done, when the results will be published in detail.

M. E. WADSWORTH.

Michigan Mining School, Houghton, July 3.

AMONG THE PUBLISHERS.

THE J. B. Lippincott Company announce as in press, "Harmony of Ancient History," by Malcolm Macdonald; "Chambers's Encyclopædia," Vol. VIII. (entirely new edition, revised and rewritten); "The Chemical Analysis of Iron," by Andrew Alexander Blair (new edition); and "A Hand-Book of Industrial Organic Chemistry," by S. C. Sadtler.

—"Whatever else we may think of this Russian censorship," says a writer in the *Pall Mall Budget*, "it must at least be admitted that its officials do their work conscientiously. A few copies of Miss Hawker's 'Mademoiselle Ixe' were recently posted to various addresses in Russia. They are now coming back to the senders with the word *Défendu* stamped on their covers. One of these returned copies now lies before me. Its leaves are cut from end to end, and evidently the book has been handled and read. Moreover, on turning over the pages, I find red pencil marks placed at various passages in the earlier part of the story. After a time they stop. The censor saw, I suppose, that it was a clear case for prohibition, and did not trouble to score the obnoxious sentiments any further. It is a compliment, however, to the

authoress that he read the story to the end—as I judge by marks of another kind."

—Dr. Paul Carus has issued, through the Open Court Publishing Co., a new edition of his "Fundamental Problems." The body of the work is not altered much; but an appendix of a hundred pages is added, in which the author enters into a quite extended discussion of some of the questions that the book raises, and replies to some of his critics. Those who agree with his general views on philosophy he treats with respect, though stoutly maintaining his own views in opposition to others; but those who have attacked his fundamental principles he treats testily and with scant courtesy. His doctrine is in no respect modified in the new edition, but remains the same rank materialism as before—a materialism not in the least disguised by calling it "monism." It is stated, too, in the same dogmatic language, in the new edition as in the old, thus: "It is undeniable that immaterial realities can not exist. The thing exists by its being material" (p. 86). Dr. Carus's book will doubtless please those of his way of thinking; but it will do nothing towards converting any one who holds opposite views.

—Leach, Shewell, & Sanborn, of New York and Boston, have just published "The Number-System of Algebra," by Professor Henry B. Fine of Princeton. The theoretical part of the book is an elementary exposition of the nature of the number-concept, of the positive integer, and of the "four artificial forms of number which, with the positive integer, constitute the 'number-system' of algebra, viz., the negative, the fraction, the irrational, and the imaginary." The point of view of the author is the one first suggested by Peacock and Gregory, that algebra is completely defined formally by the laws of combination to which its fundamental operations are subject: that, speaking generally, these laws alone define the operations; and that the operations define the various artificial numbers, as their formal or symbolic results. The historical part of the volume contains a review of the history of the most important parts of elementary arithmetic and algebra.

—No. 38 of the Scovill Photographic Series, just published, is "Photographic Reproduction Processes," by P. C. Duchochois (New York, Scovill & Adams Co., \$1.) It makes a neat octavo volume of 121 pages, and is a practical treatise on photo-impressions without silver salts, for the use of photographers, architects, engineers, draughtsmen, and wood and metal engravers. The author describes, in language readily understood by both amateur and professional, all the processes employed to reproduce plans, designs, engravings, *clichés* on paper, wood, glass, and metal plates; besides giving a complete description of the uranotype, aniline, platinotype, and improved carbon processes. The authors quoted are almost "legion," but the quotations are judiciously made; and as the point in view is to show results, as well as how to achieve them in the most direct way, the quotations are of immediate benefit to the reader without detracting in the slightest from the credit due the person quoted from, due credit being given in each instance.

—A recent issue of the Johns Hopkins Press is a pamphlet on the "Public Lands and Agrarian Laws of the Roman Republic," by Andrew Stephenson. It begins with a brief account of the land belonging to early Rome, the *Ager Romanus* and the *Ager Publicus*, followed by a general description of the Roman colonies, whose history is inseparably bound up with that of the land. The author then proceeds to describe in considerable detail the various agrarian laws, from the Lex Cassia to the establishment of the empire. To give a thoroughly satisfactory account of the Roman land laws apart from the general history of the republic is hardly possible; but, allowance being made for that drawback, Mr. Stephenson's work is worthy of praise. It is somewhat dry in style, but it gives evidence not only of a careful study of the facts but of a good deal of thinking about the facts. We like in particular the care with which the author expounds the character and meaning of the various laws under review, the circumstances which led to their enactment, and the actual effect they had. Mr. Stephenson informs us in his preface that this monograph is intended, not merely as a study in Roman history, but also as the precursor of a book on agrarian movements in recent times and in nations nearer home.

— The seventh volume of "Chambers's Encyclopædia," which has just appeared, ranges from Maltebrun to Pearson. Geographical articles are the most prominent feature of the volume, there being descriptions of no less than seventeen of the American States and Territories, together with articles on Mexico, New Zealand, several of the Canadian provinces, and the cities of Paris, New York, Moscow, and many others. The articles on the different parts of the United States are by American writers, and a few other articles are also from American pens. Besides the geographical papers mentioned, there are various other articles of interest to men of science. Professor P. G. Tait treats of "Matter," Dr. J. P. Steele of "Medicine," and Dr. John Murray describes the Pacific Ocean and the Mediterranean Sea. The Rev. E. B. Kirk treats of the moon and of meteors, Professor James Geikie of mountains and of paleontology, Dr. Buchan of meteorology, etc. Literature and history are less fully represented; but there are papers on novels, newspapers, mythology, etc., and sketches of Mills, Milton, Napoleon, and many less noted men. Among the most important papers in the volume are those on Mohammed and the religion he founded, written by Professor Emmanuel Deutsch and Rev. John Milne; while the longest of all the articles, we believe, is on the subject of the navy. Other noticeable papers treat of painting, music, parliament, numismatics, and, in short, of all important topics in this part of the alphabetical list. The volume is characterized by the same qualities that we have noted in the earlier ones, clearness and conciseness combining to convey a

large amount of information in available form and in moderate space. Published in this country by J. B. Lippincott Co., Philadelphia.

— While engaged in explorations on behalf of the Geological Survey of Canada in 1889 and 1890, Mr. J. B. Tyrrell discovered an area of Silurian rocks on the north-east side of Lake Winnipegosis, on Cedar Lake, and on the Saskatchewan River below Cedar Lake. From these rocks an interesting series of fossils was obtained, some of which are apparently new to science. Of these latter, four of the most characteristic or important species are described and illustrated in a pamphlet just issued by J. F. Whitteaves, entitled "Descriptions of Four New Species of Fossils from the Silurian Rocks of the South-eastern Portion of the District of Saskatchewan."

— In the August *Popular Science Monthly*, Hon. Carroll D. Wright discusses the value of statistics, explaining how tables of figures should be used, and showing how they are sometimes made to give false evidence; Dr. Andrew D. White, in his article entitled "From Fetich to Hygiene," presents a terrible picture of the ravages of epidemics in times when prayers and processions were the only means relied upon to check them; Mr. S. N. D. North concludes "The Evolution of the Woolen Manufacture," with dyeing and finishing processes, and some general features of the industry (fully illustrated). The same number contains the first of a series of illustrated articles on "Dress and Adornment."

Publications received at Editor's Office,
June 24-July 14.

CHAMBERS'S ENCYCLOPÆDIA. New ed. Vol. VII. Maltebrun to Pearson. Philadelphia, Lippincott. 828 p. 4°. \$3.
DUCHOCCHOIS, P. C. Photographic Reproduction Processes. New York, Scovill & Adams Co. 121 p. 8°. \$1.
HORNADAY, W. T. Taxidermy and Zoological Collecting. New York, Scribner. 362 p. 8°. \$2.50.
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— The Forest and Stream Publishing Co. have ready a second and enlarged edition of C. P. Kunhardt's "Small Yachts, their Designs and Construction." The work has been extended by the addition of many new plates.

— Among the more recent publications of the American Book Company is "Advanced Lessons in English Grammar," by W. H. Maxwell, superintendent of public instruction in Brooklyn. It is intended for use in higher grammar classes. It is the third volume of Maxwell's English series, and the work embraces all the theory and practice necessary during the last two years of a grammar school course, or throughout a high school course. It is intended to serve the double purpose of a text-book and a book of reference. A valuable feature of the book is the chapter on

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